Start Guide

Generating an ENI file for EtherCAT Network, and import to QEC EtherCAT Master

86Duino Coding IDE 500

EtherCAT Library

(Version 1)

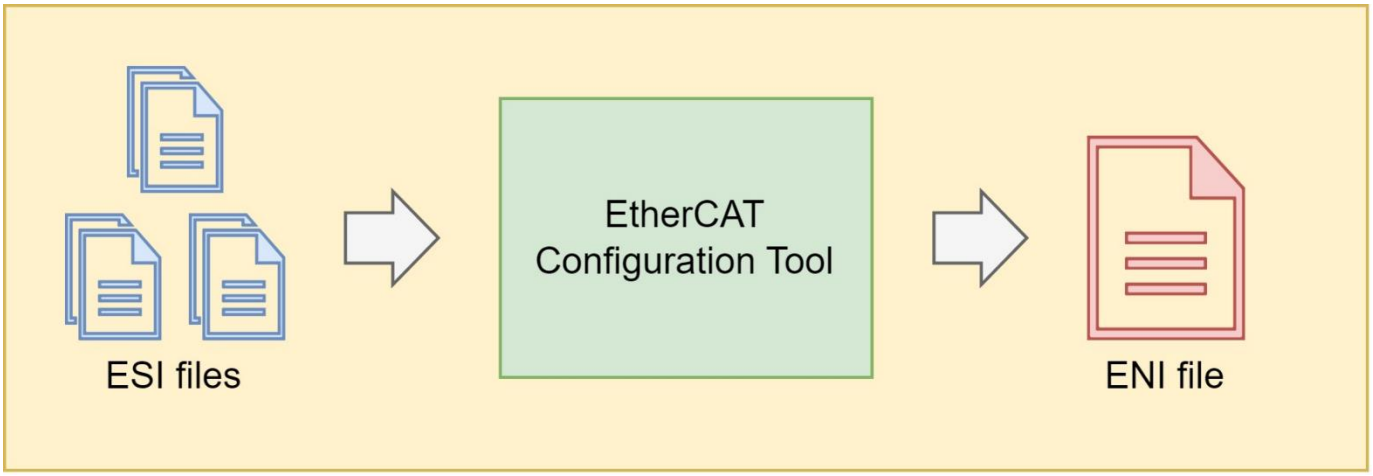
Revision

Date	Version	Description
2024/7/23	Version1.0	New Release.

Preface

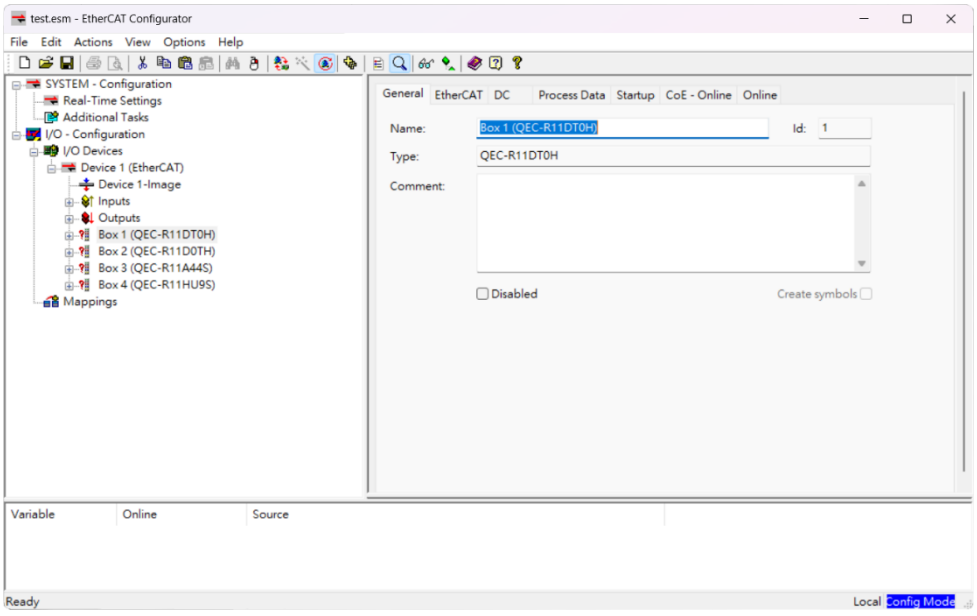
This guide is a quick reference for creating an ENI file for use in the 86Duino Coding IDE 500.

The EtherCAT Network Information (ENI) file contains the essential settings needed to configure an EtherCAT network. This XML-based file includes general information about the master and the configurations of every slave device connected to it. Using the EtherCAT Configuration Tool, you can read ESI files or perform an online scan of the network to detect all connected slaves. You can then configure relevant EtherCAT settings, such as PDO mapping and enabling DC, and export the ENI file.



The EtherCAT Technology Group requires that the EtherCAT Master Software support at least one of the following methods in the Network Configuration section: Online Scanning or Reading ENI.
The EtherCAT Library in the 86Duino IDE 500+ of QEC EtherCAT supports both methods. However, when reading ENI, the library currently extracts only partial information from the ENI file for network configuration. For more details, please refer to 3.1 About ENI Configuration in 86Duino IDE.

In this guide, we provide a brief overview using the ET9000 tool.

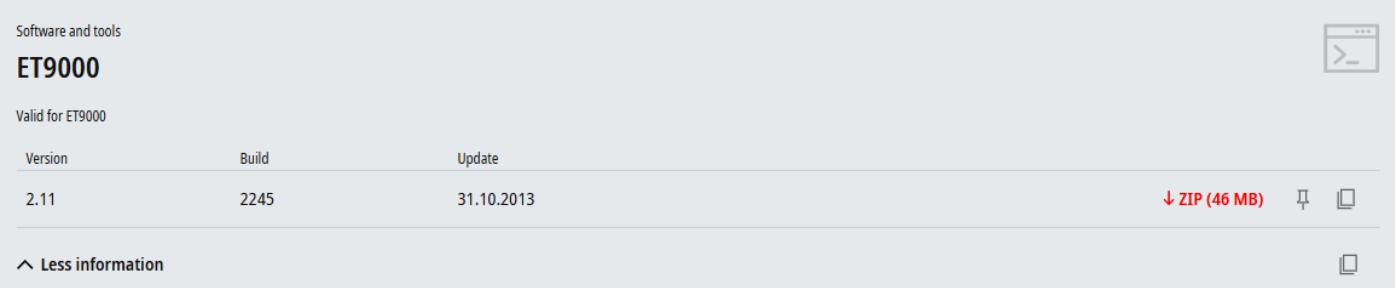


1. Download an EtherCAT Configurator

The EtherCAT Configurator is a program by Beckhoff whose primary function is to generate the ENI file (see EtherCAT Overview). It can also read out ESI files and help debug your system by checking individual devices. In this guide, we're using the ET9000 tool.

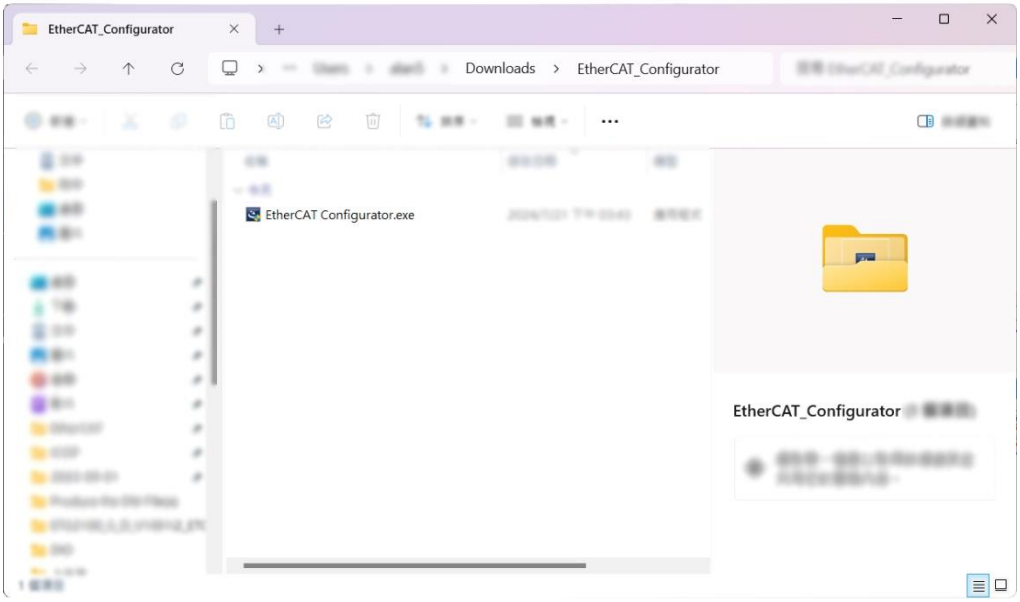
1.1 Download ET9000

1. Access the web page of Beckhoff to download the software product ET9000 (EtherCAT Configurator): http://download.beckhoff.com/download/software/EtherCAT/Development_Products/EtherCAT_Configurator.zip



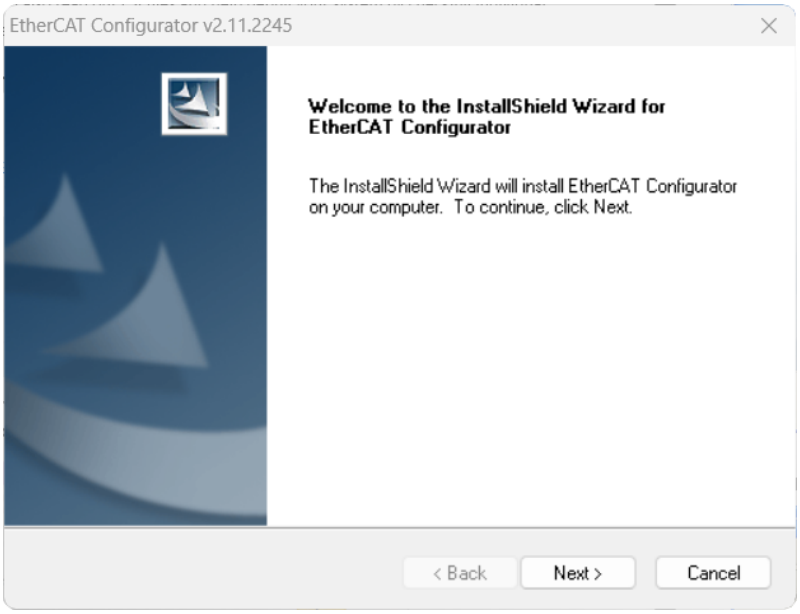
2. After downloading, you'll get a .zip file for ET9000, which contains the install executable file.

3. Extract the .zip file to find the executable file EtherCAT_Configurator.exe.



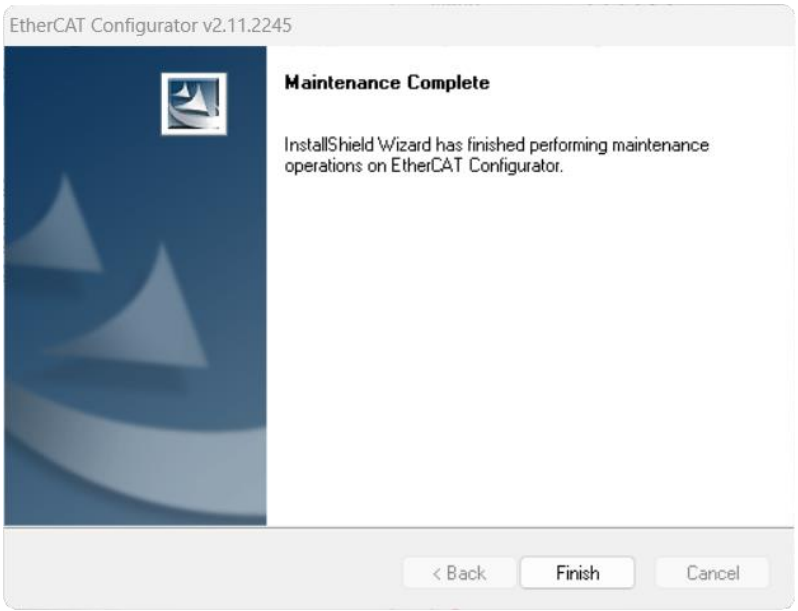
1.2 Install ET9000

1. Run the Installer:
   - Open the extracted folder and locate the EtherCAT_Configurator.exe file.
   - Double-click on the executable file to start the installation process.

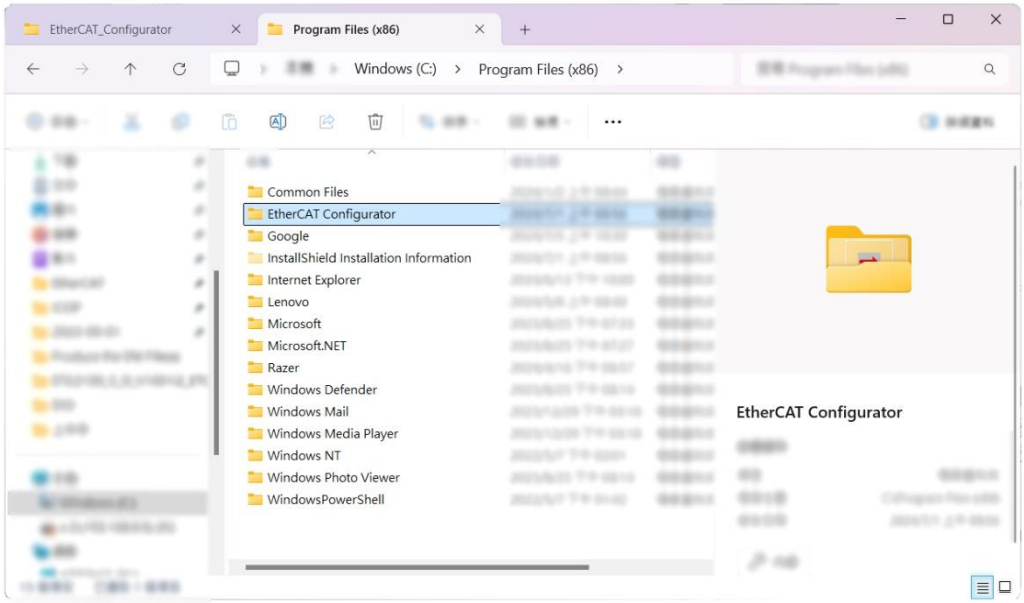


2. Follow the Installation Wizard:
   - The ET9000 installation wizard will open. Click "Next" to continue.
   - Read and accept the license agreement, then click "Next."
   - Choose the installation location or use the default location, then click "Next."
   - Click "Install" to begin the installation.

3. Complete the Installation:
   - Once the installation is complete, click "Finish" to close the wizard.

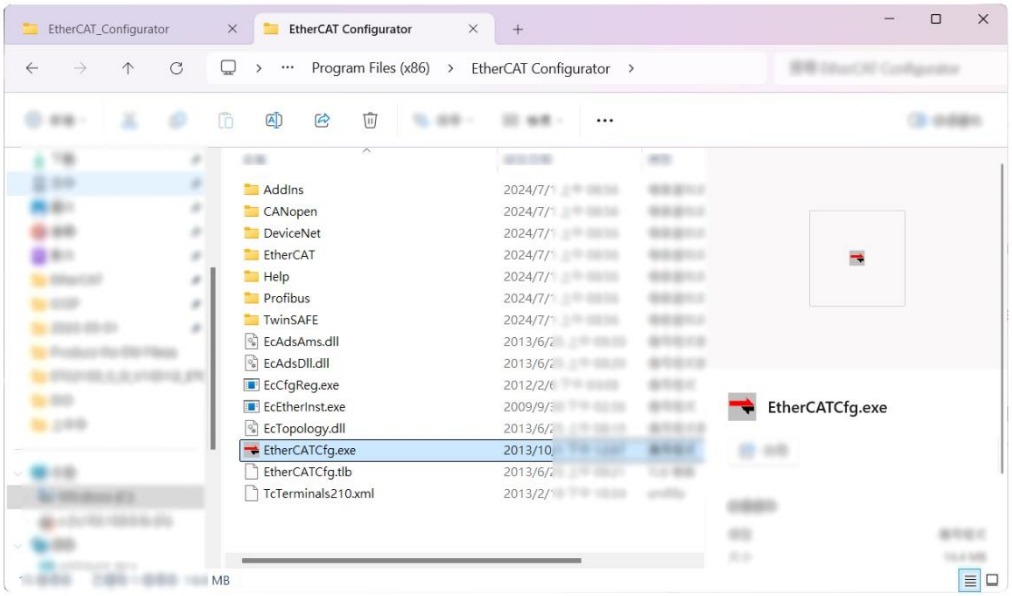


4. Verify the Installation:
   - To ensure the installation was successful, navigate to the installation directory (default: C:\Program Files\EtherCAT Configurator) and verify that the application files are present.

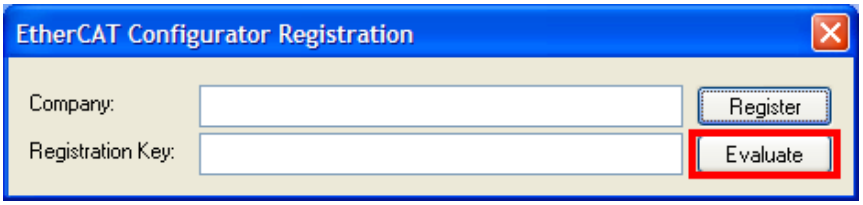


1.3 Launch ET9000

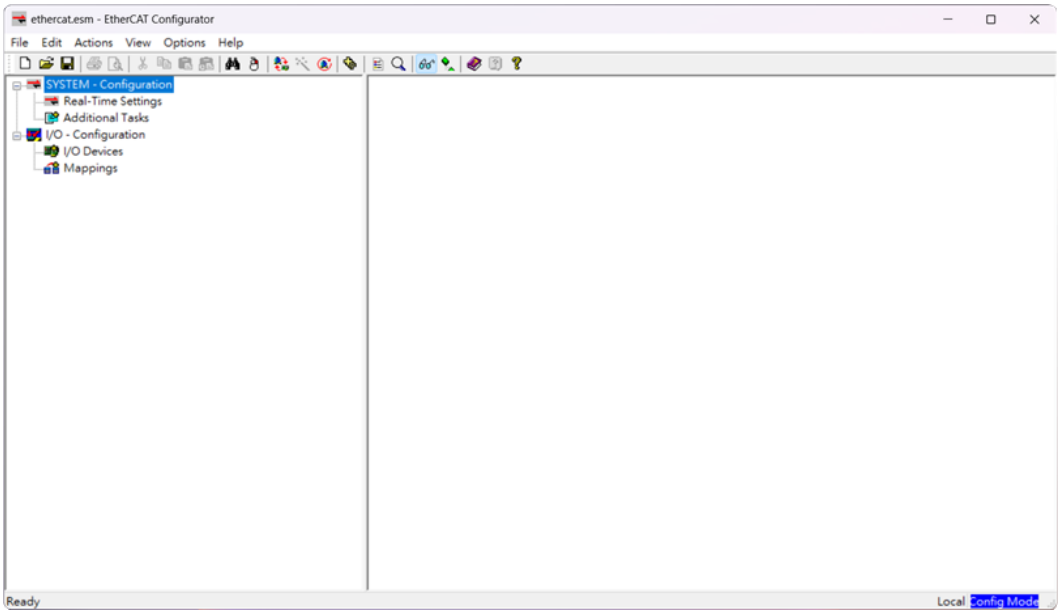
1. Launch ET9000:
   - Navigate to the installation directory (default: C:\Program Files\EtherCAT Configurator).
   - Locate and double-click EtherCAT_Configurator.exe to launch the ET9000 tool.



2. Initial Setup:
   - When ET9000 starts for the first time, you may be prompted to select an evaluation or license mode.
   - Click “Evaluate” to use the evaluation version.



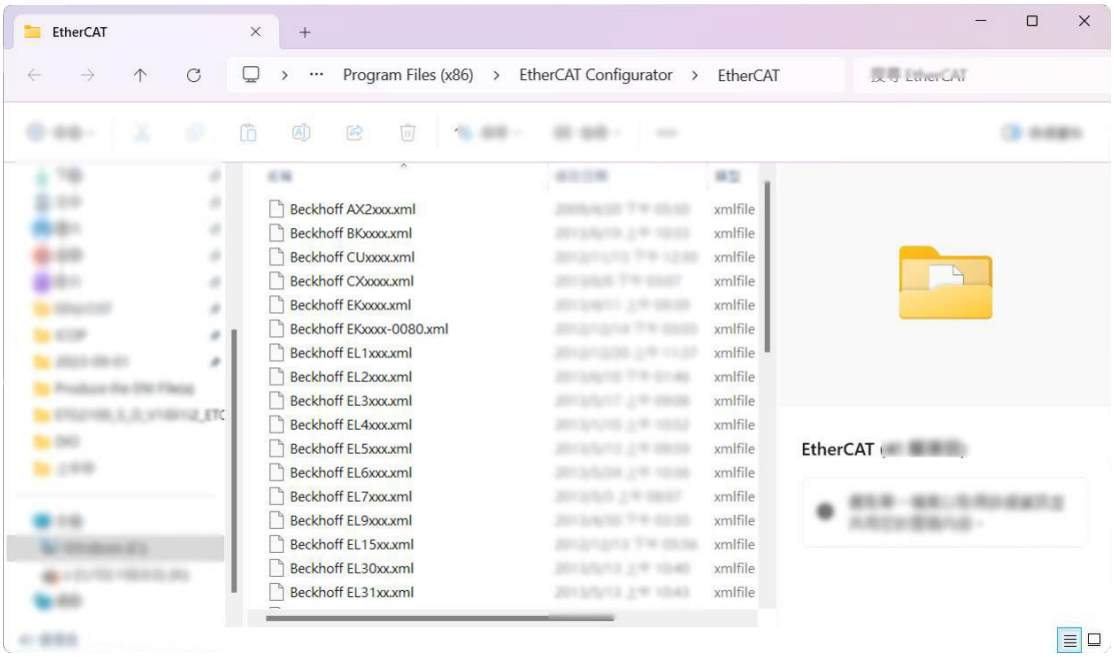
3. After completing the initial setup, you can start using ET9000.



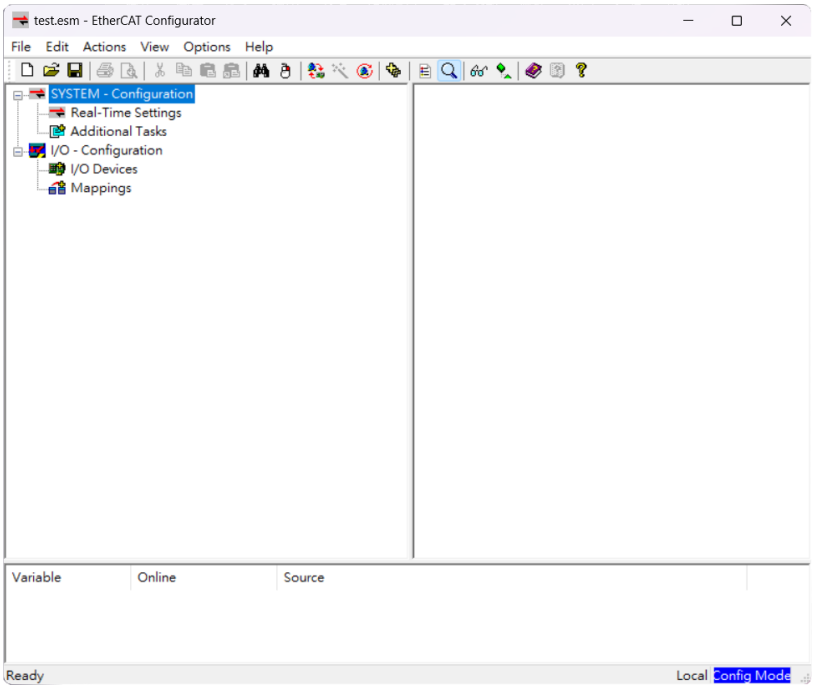
2. Generating/Exporting ENI Files (.XML)

2.1 Scanning for Devices

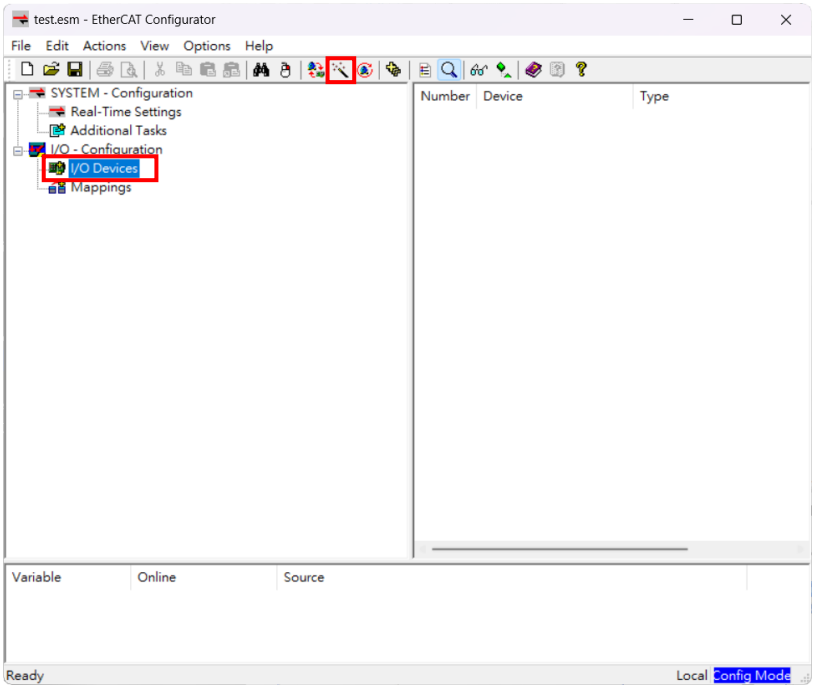
1. Adding ESI file for your Slaves:
   - Place the ESI file for the EtherCAT slave in the EtherCAT folder of the ET9000 installation path (e.g., *C:\Program Files\EtherCAT Configurator\EtherCAT*).



2. Open ET9000:
   - Ensure ET9000 is running and you are on the main interface.
   - Start a New Project.

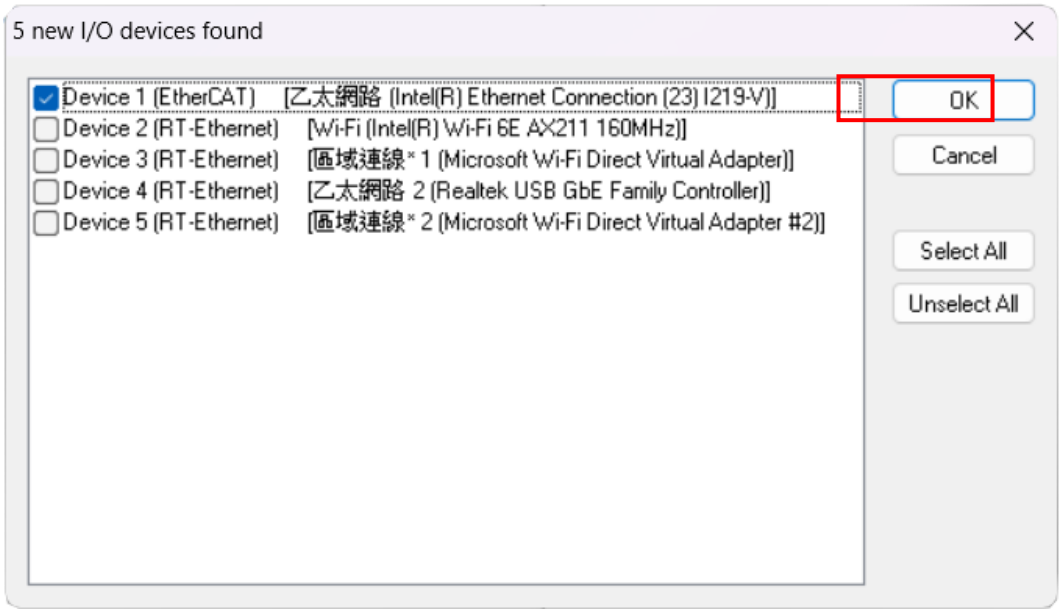


3. Scan for Devices:
   - Select “I/O Devices” from the navigation pane.
   - Click the “Scan Sub Devices” button to detect all connected EtherCAT devices.

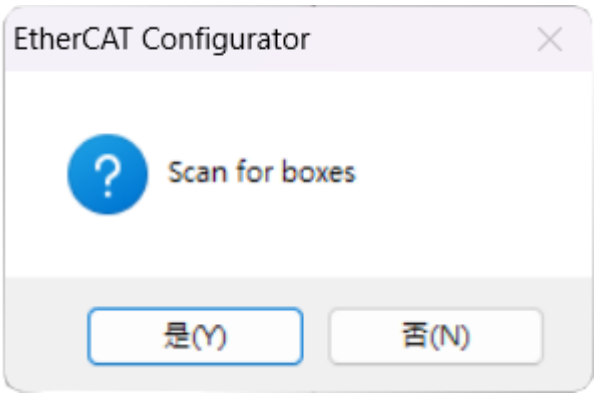


4. Click the “OK” button for the warning windows.

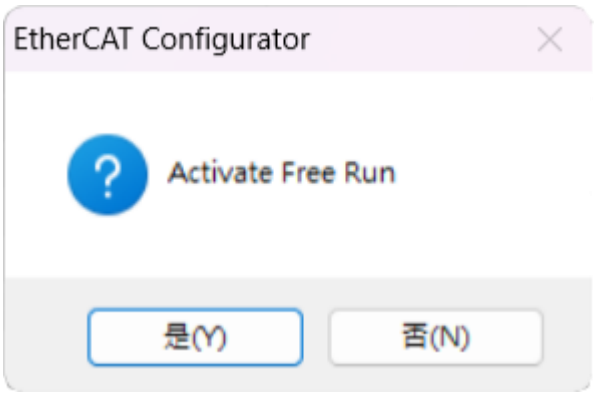
5. Confirm Device Detection:
   - If only one Ethernet adapter is connected, you should see one EtherCAT device listed.
   - Select the detected EtherCAT device and click “OK.”



6. Click “Yes” button to find slave automatically.

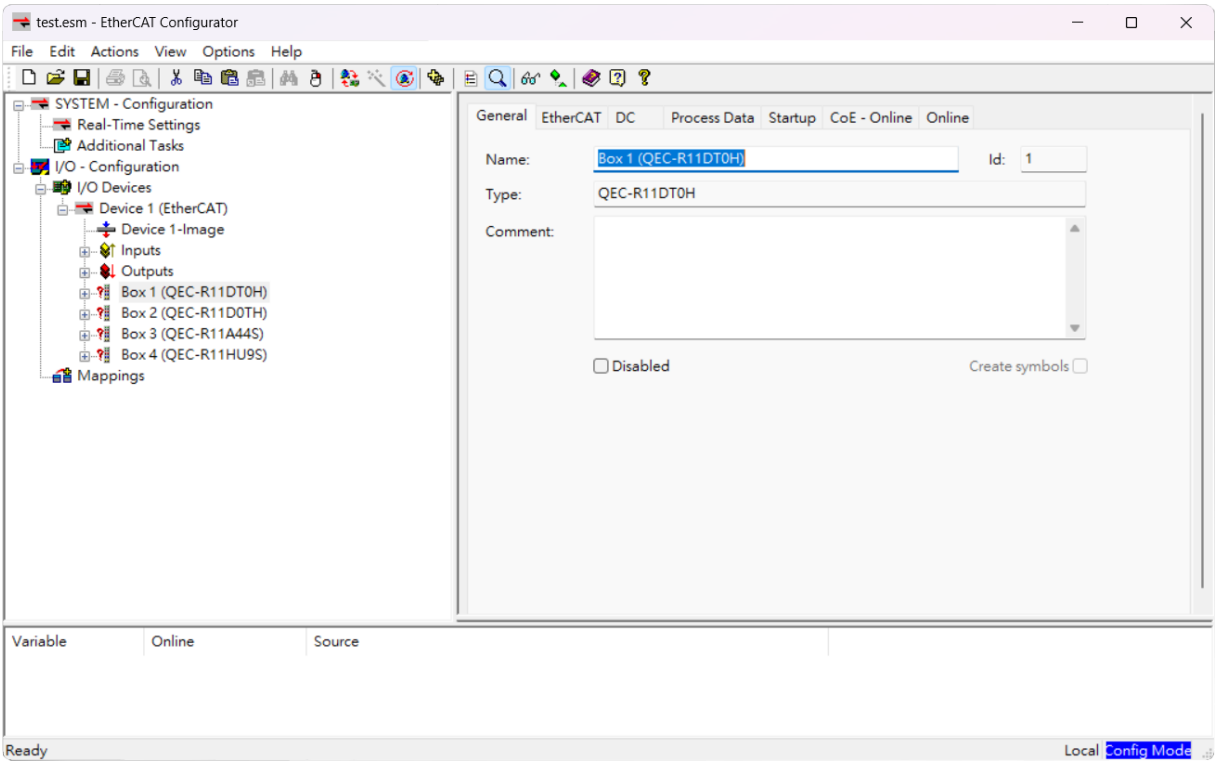


7. After the scan is complete, you can see the “Activate Free Run” windows and click the “OK” button to start your EtherCAT System.

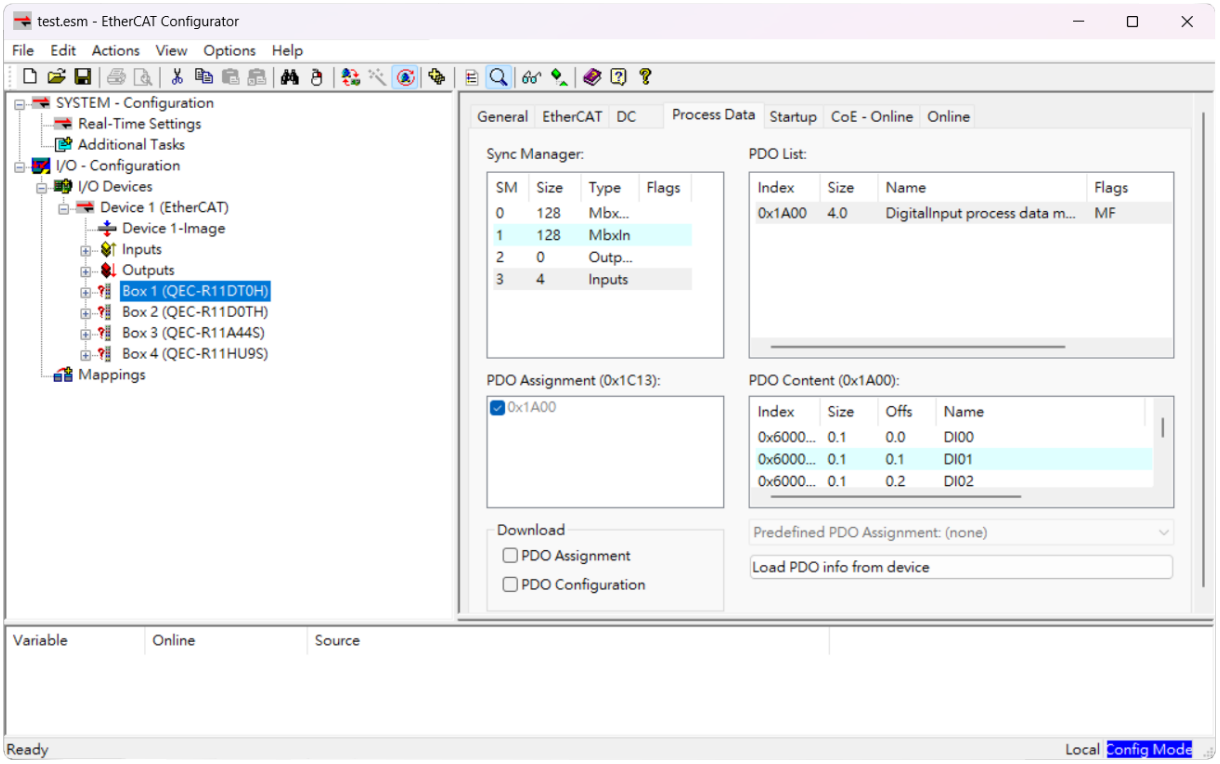


2.2 Configure the Slave

1. Configure Slave Settings:
   - In this chapter, we will guide you through generating and configuring an ENI file using four QEC Slaves: QEC-R11DT0H, QEC-R11D0TH, QEC-R11A44S, and QEC-R11HU9S.

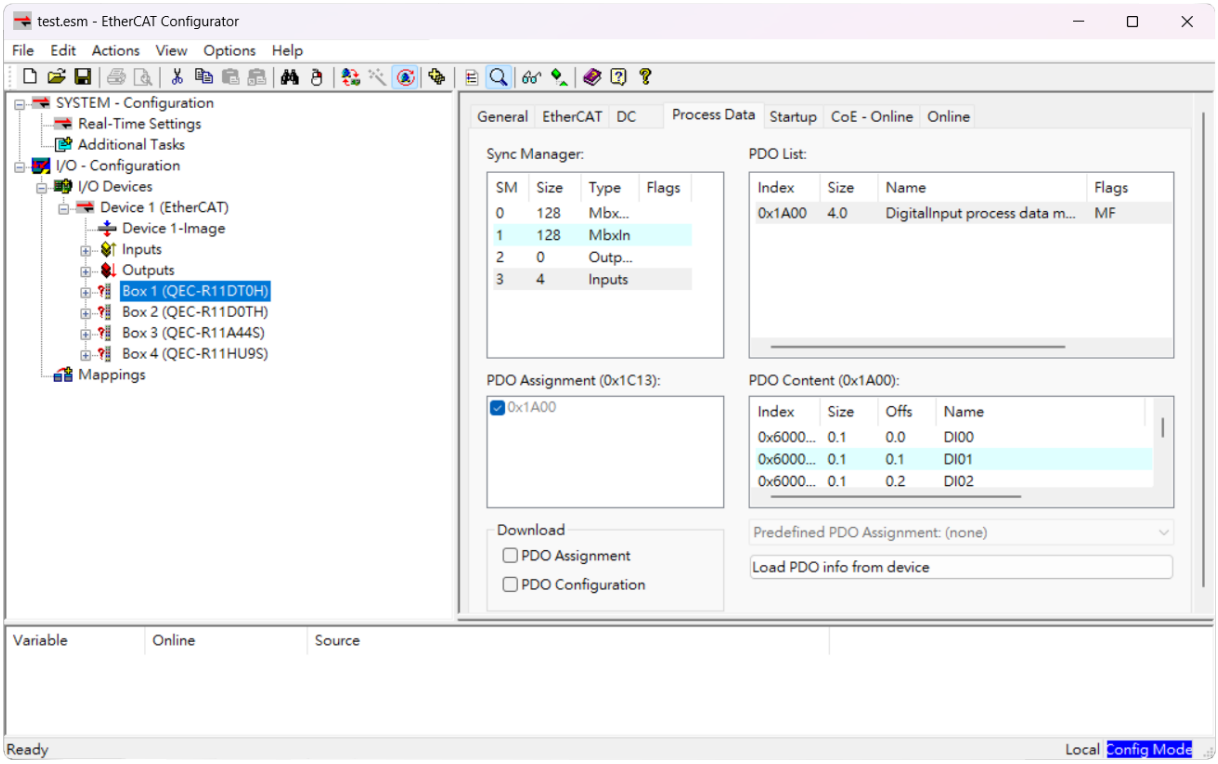


   - Configure each detected or added slave device as needed. This may include setting PDO mappings, enabling Distributed Clocks (DC), and other relevant settings.

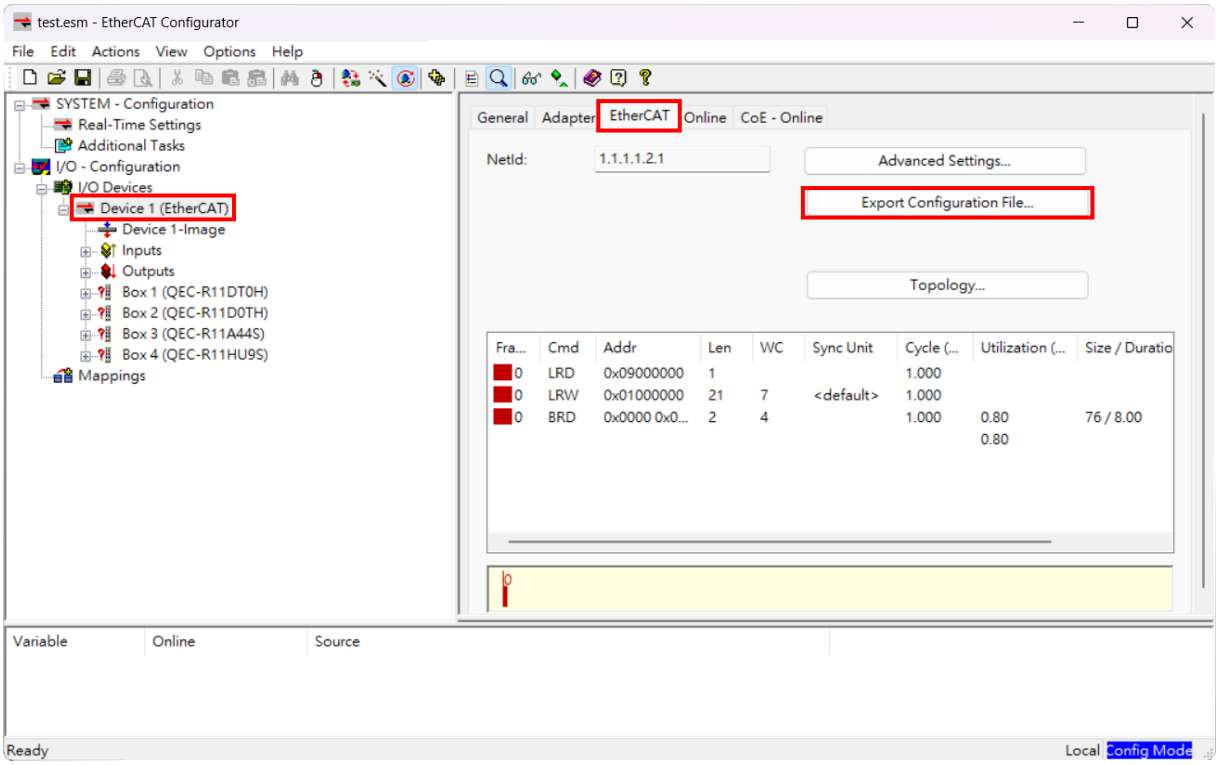


2.3 Export Configuration File

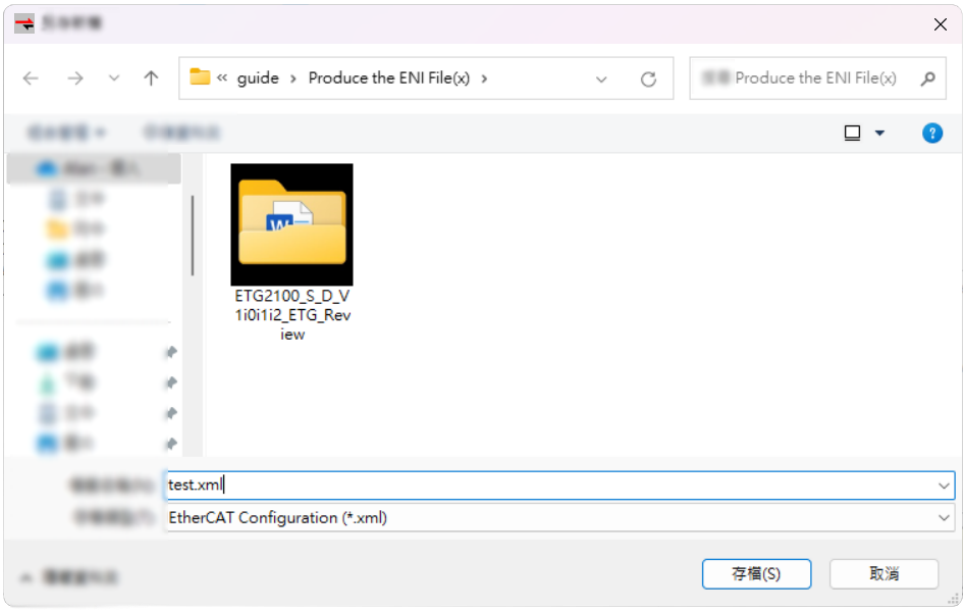
1. Verify Configuration:
   - Ensure that all QEC Slaves are correctly configured and active in your EtherCAT network.



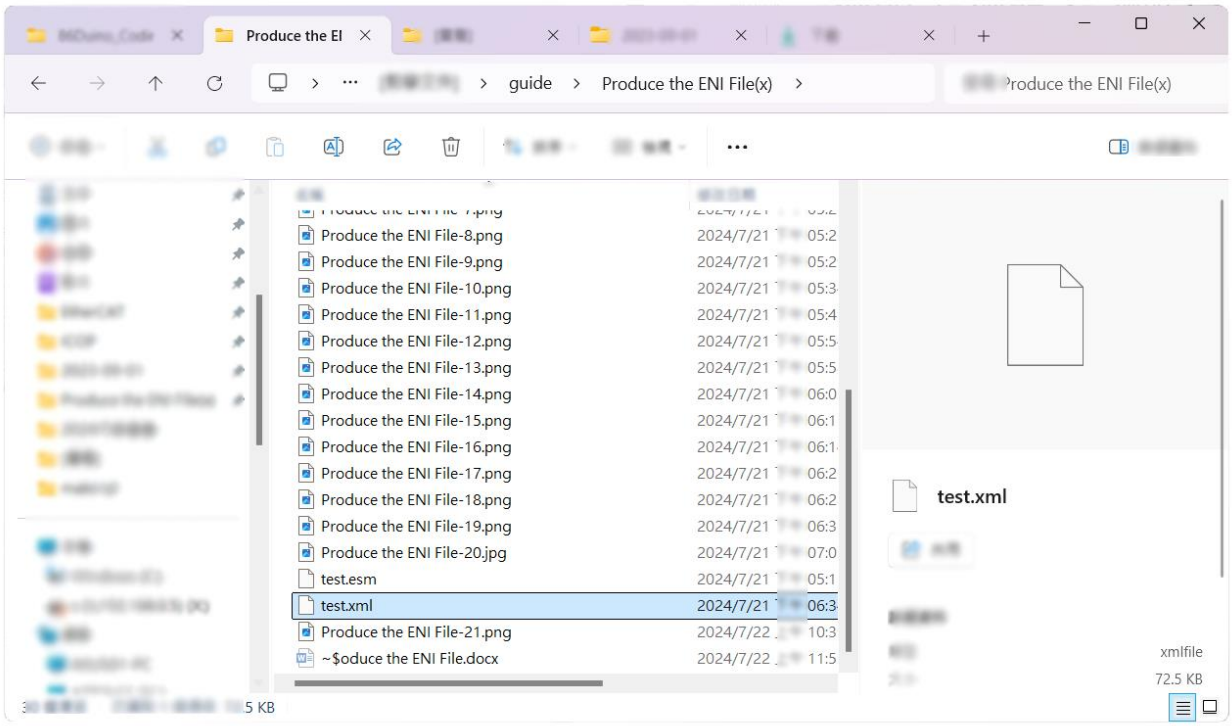
2. Export the ENI File:
   - Select “Device 1 (EtherCAT)” from the device list.
   - Click on the “Export Configuration File” button located in the “EtherCAT” tab.



3. Save the ENI File:
   - Choose a location to save the ENI file and click “Save.”



   - You will save a .xml file, which is the ENI file.

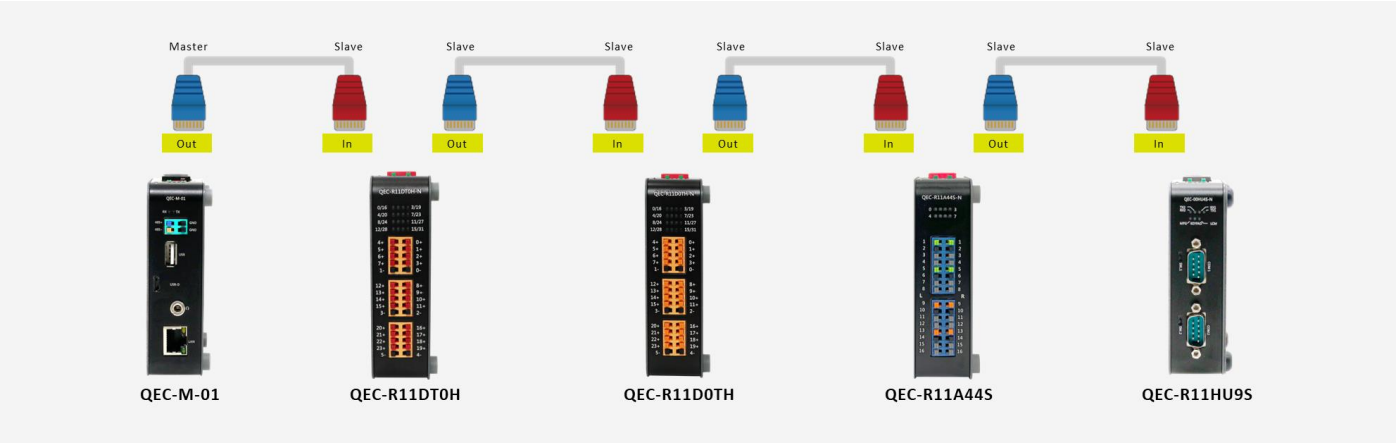


In this chapter, we have walked through the steps necessary to generate and export an ENI file using the ET9000 tool, with specific configurations for four QEC Slaves: QEC-R11DT0H, QEC-R11D0TH, QEC-R11A44S, and QEC-R11HU9S. By scanning for devices, adding the necessary ESI files, and configuring each slave appropriately, you can ensure that your EtherCAT network is correctly set up and ready for operation. Finally, exporting the ENI file completes the configuration process, providing a comprehensive XML-based file that contains all the necessary settings for your EtherCAT network. With this ENI file, you can now proceed to integrate it into your EtherCAT Master for efficient and effective network management.

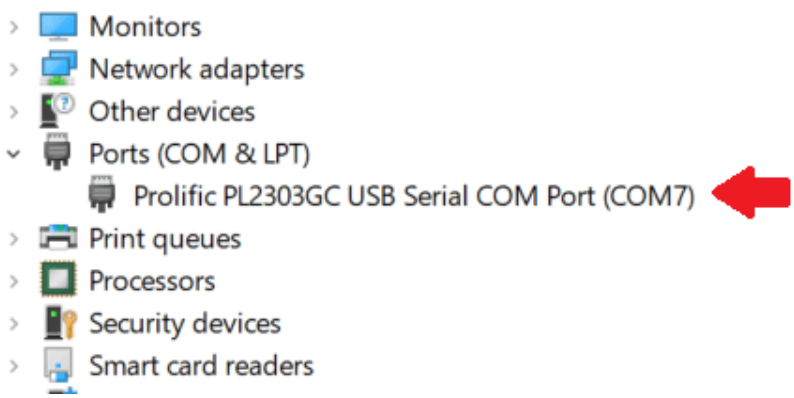
3. Importing the ENI File into QEC EtherCAT Master

3.1 Preparing the QEC EtherCAT Master and the Software

1. Ensure the QEC EtherCAT Master is Ready:
   - Verify that the QEC EtherCAT Master hardware is properly connected to your EtherCAT network.



2. Ensure the 86Duino IDE 500+'s Software/Development Environment is Installed on Your Computer:
   - Download 86duino IDE from https://www.qec.tw/software/.
   - Connect to your PC and set up the environment:
     a. Connect the QEC-M-01P to your PC via a Micro USB to USB cable (86Duino IDE installed).
     b. Turn on the QEC power.
     c. Open "Device Manager" (select in the menu after pressing Win+X) ->" Ports (COM & LPT)" in your PC and expand the ports; you should see that the "Prolific PL2303GC USB Serial COM Port (COMx)" is detected; if not, you will need to install the required drivers. (For Windows PL2303 driver, you can download here)



     d. Select the correct board: In the IDE's menu, select Tools> Board > QEC-M-01 (or the QEC-M master model you use).
     e. Select Port: In the IDE's menu, select Tools > Port and select the USB port to connect to the QEC-M master (in this case, COM4 (QEC)).

3.2 Importing the ENI File

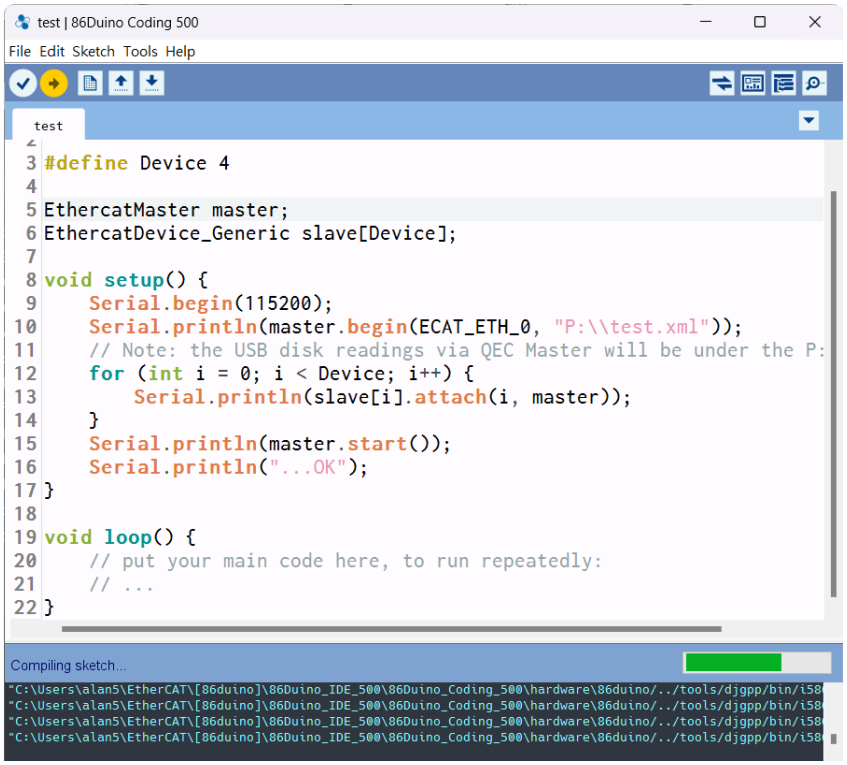
3.2.1 Method 1: Using Code

After setting up your 86Duino IDE environment, please put the ENI file on a USB disk and insert it into your QEC EtherCAT Master. (Note: the USB disk readings via QEC Master will be under the P:\\ path.)

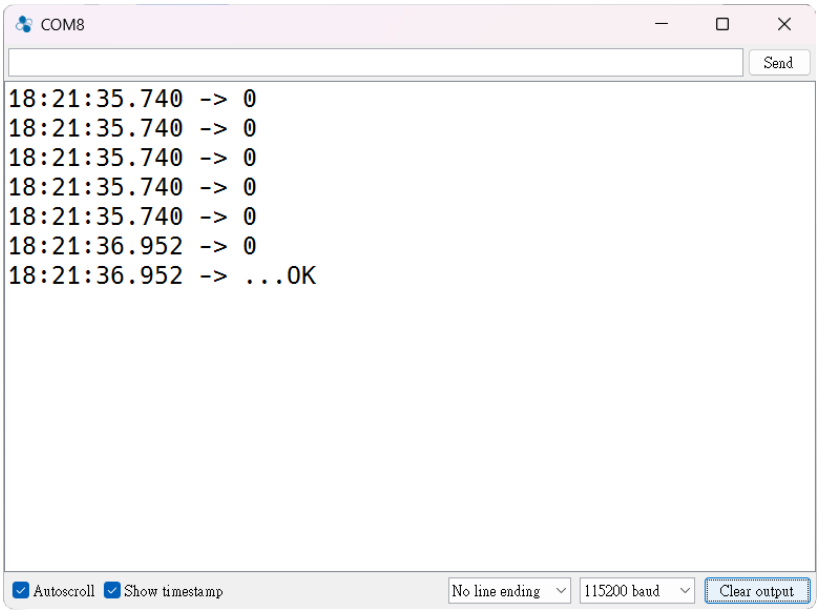
1. Write the Import Code:
   - In your project code, use the `EthercatMaster::begin()` function to import the ENI file.
   - Example code:

```
#include "Ethercat.h"

#define Device 4

EthercatMaster master;
EthercatDevice_Generic slave[Device];

void setup() {
    Serial.begin(115200);
    Serial.println(master.begin(ECAT_ETH_0, "P:\\test.xml"));
    // Note: the USB disk readings via QEC Master will be under the P:\\ path.
    for (int i = 0; i < Device; i++) {
        Serial.println(slave[i].attach(i, master));
    }
    Serial.println(master.start());
    Serial.println("...OK");
}

void loop() {
    // put your main code here, to run repeatedly:
    // ...
}
```

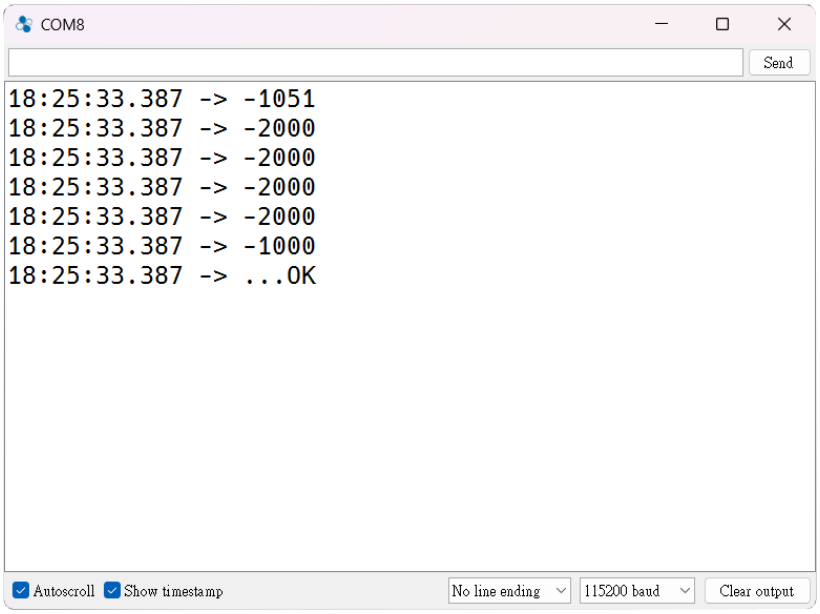
2. Upload the Code:
   - Upload the code to your QEC EtherCAT Master.



3. Verify the ENI File Import:
   - Verify that the ENI file is correctly imported and the network is operational via Serial Monitor.
   - If the ENI file is imported successfully, you will see the following return value in Serial Monitor:

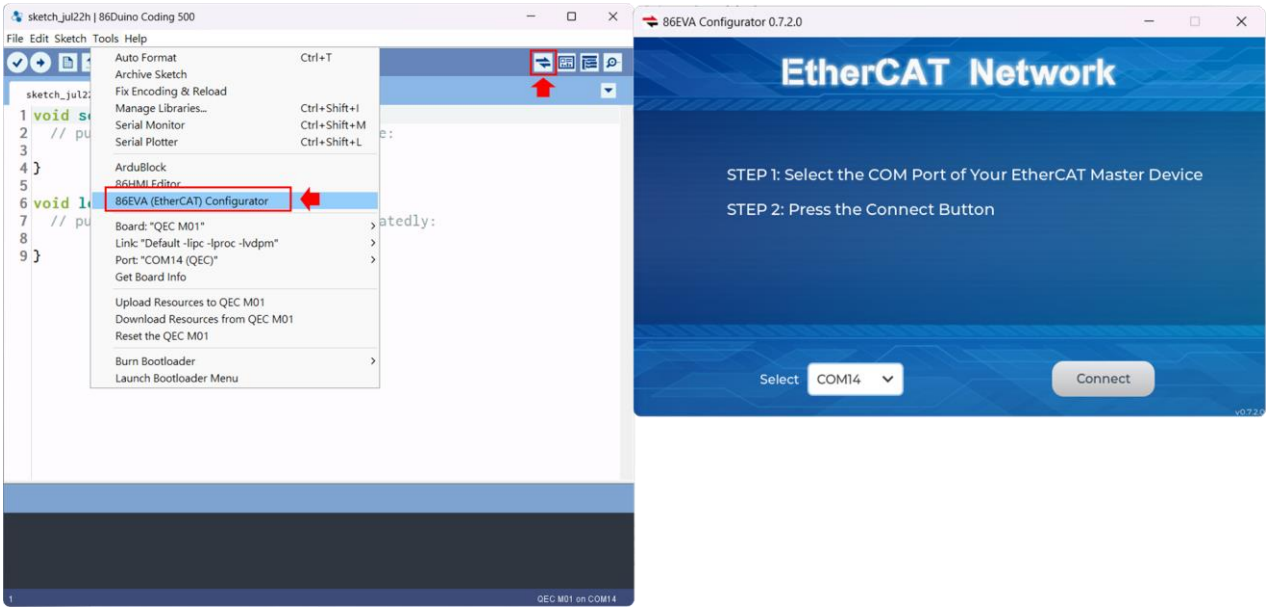


- If there is an error, such as -1051 (which means ECAT_ERR_MASTER_ENI_MISMATCH), refer to the EtherCAT API user manual for other error codes and their meanings.



3.2.2 Method 2: Using 86EVA

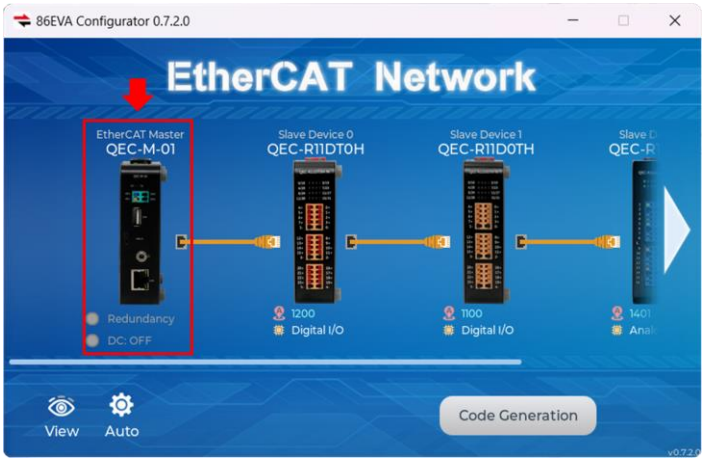
1. Turn on 86EVA and scan:
   - The 86EVA tool can be opened via the following buttons.



   - Once you have confirmed that the correct COM port has been selected of QEC-M-01P, press the Connect button to start scanning the EtherCAT network.

   - The connected devices will be displayed after the EtherCAT network has been scanned.

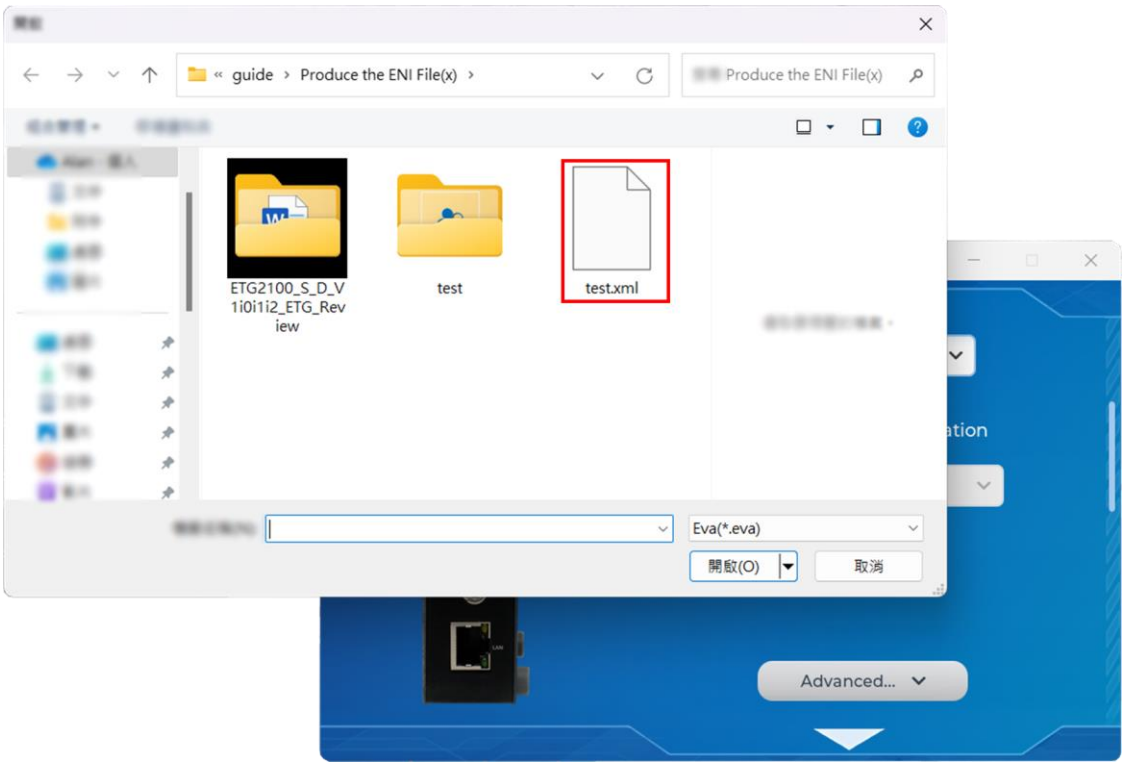
2. Import ENI file:
   - Press twice on the QEC-M-01 to enter the corresponding parameter setting screen.



   - You can see the parameter settings for the QEC-M-01.

   - Click on the “Open” button next to the “Select ENI file” in the General area.

- Browse where you saved the ENI file in Chapter 2, and open it.

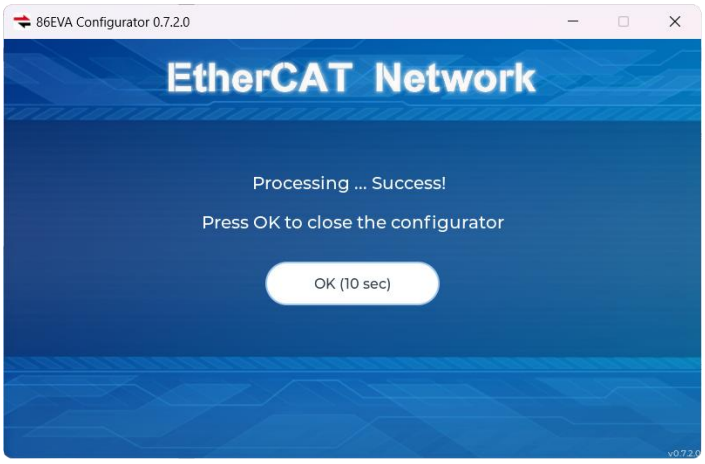


- After you import the ENI file into the 86EVA, you can see the ENI file name.

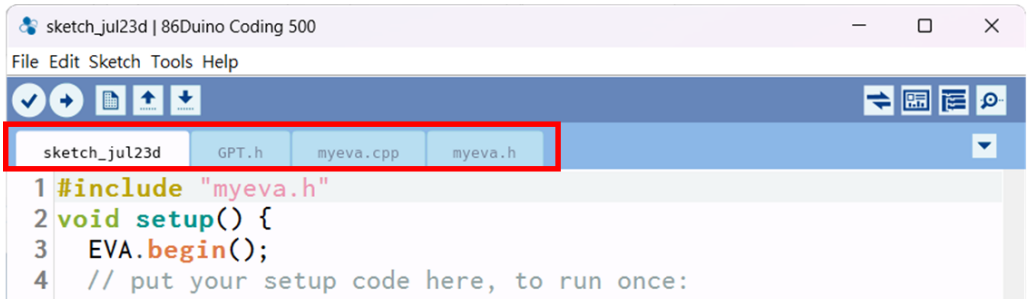
- Please click “Back” button in the upper left corner to return.

3. Generate the code:
   - Go back to the home screen and press the "Code Generation" button in the bottom right corner.

   - When you're done, double-click the OK button to turn off 86EVA, or it will close in 10 seconds.



   - The generated code and files are as follows:

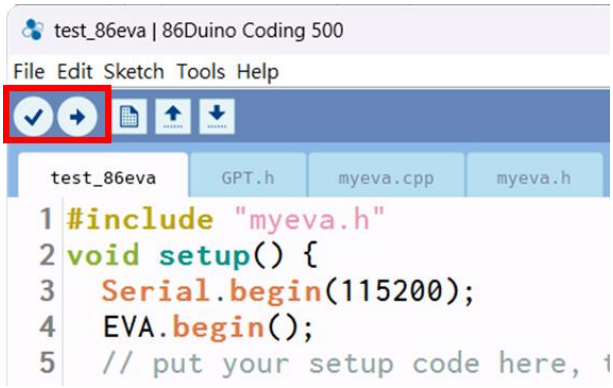


   a. sketch_jul23d: Main Project (.ino, depending on your project name).
   b. GPT.h: Parameters to provide to ChatGPT referred.
   c. myeva.cpp: C++ program code of 86EVA.
   d. myeva.h: Header file of 86EVA.

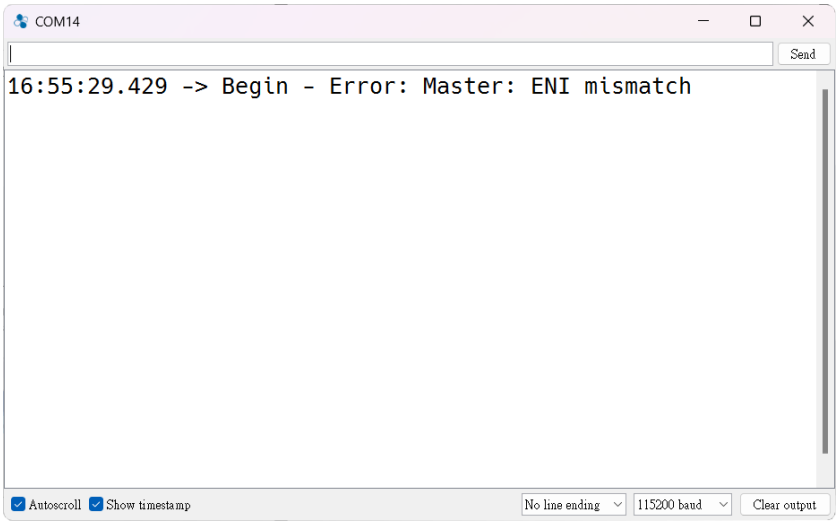
4. Write the code:
   - Please insert `Serial.begin(115200);` before `EVA.begin();` in `void setup() {}`, so the EVA program return value can display in Serial Monitor (in baud rate 115200).

```
#include "myeva.h"

void setup() {
  Serial.begin(115200);
   EVA.begin();
  // put your setup code here, to run once:
}

void loop() {
  // put your main code here, to run repeatedly:
}
```

   - Once the code is completed, click on the toolbar to  compile, and to confirm that the compilation is complete and error-free, you can click  to upload. The program will run when the upload is complete.



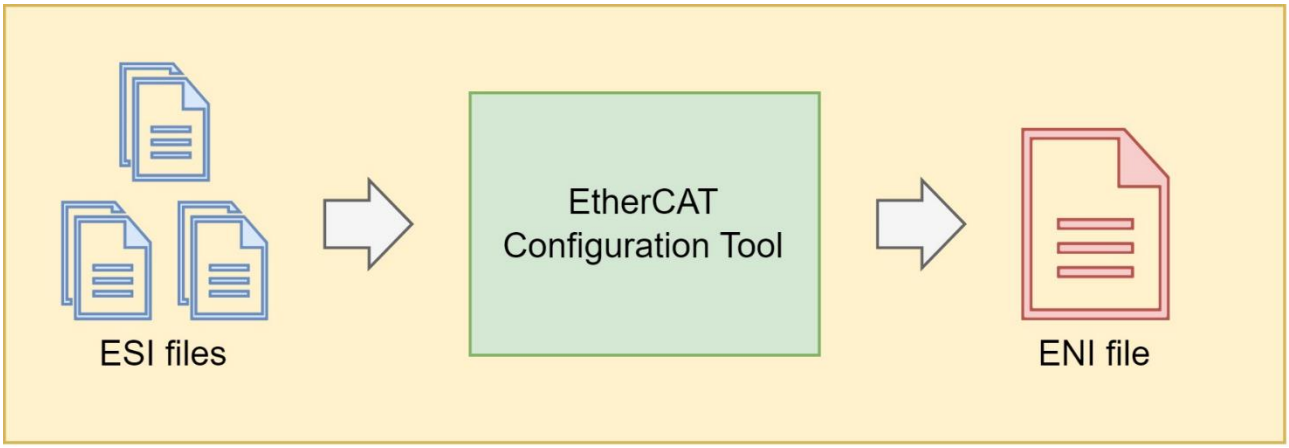
5. Verify the ENI File Import:
   - Verify that the ENI file is correctly imported and the network is operational via Serial Monitor.
   - If the ENI file is imported successfully, the Serial Monitor will return nothing; if there is an error, it will return the error directly to the Serial Monitor.



Appendix

A1. About ENI Configuration in 86Duino IDE

The EtherCAT Network Information (ENI) contains the necessary settings to configure an EtherCAT network. The XML-based file contains general information about the master and the configurations of every slave device connected to the master. The EtherCAT Configuration Tool reads the ESI files or online scans the network for all slaves, then user can configures relevant EtherCAT settings, such as PDO mapping and enabling DC, and then export the ENI file.



The EtherCAT Technology Group specifies that the EtherCAT Master Software must support at least one of the following in the Network Configuration section: Online Scanning or Reading ENI. This library, however, supports both. In the case of Reading ENI, this library currently extracts only partial information from the ENI file for network configuration.

The extracted information includes the following:

`EtherCATConfig : Config : Slave : Info`

- Elements
  - VendorId
  - ProductCode
- Attribute
  - Identification : Value
- Purpose
  Used to check whether the EtherCAT slaves on the network match the slaves specified in the ENI file. The checking rules are as follows:
  - Check if the number of slaves in the ENI file matches the number of slaves on the network.
  - For slaves in the ENI file with the Identification: Value attribute, check if there are slaves on the network with matching Alias Address and Identification: Value attribute, as well as Vendor ID and Product Code. If such slaves exist, it indicates a successful match.

- For slaves with the Identification: Value attribute that fail to match, or those without this attribute, check if the Vendor ID and Product Code of the slave with the same sequence number on the network match.

`EtherCATConfig : Config : Slave : Mailbox`

- Elements
  - Send : MailboxSendInfoType : Start
  - Recv : MailboxRecvInfoType : Start
- Purpose
  Used to configure the mailbox Physical Start Address of an EtherCAT slave.

`EtherCATConfig : Config : Slave : Mailbox : CoE`

- Elements
  - InitCmds : InitCmd : Index
  - InitCmds : InitCmd : SubIndex
  - InitCmds : InitCmd : Data
  - InitCmds : InitCmd : Timeout
- Attribute
  - InitCmds : InitCmd : CompleteAccess
- Purpose
  After switching the EtherCAT state machine to the Pre-Operational state, execute the CoE initialization commands for the EtherCAT slave in `EthercatMaster::begin()`.

`EtherCATConfig : Config : Slave : ProcessData`

- Elements
  - Recv : BitLength
  - Send : BitLength
- Purpose
  The bit length of the output process data and input process data of an EtherCAT slave is provided to the firmware for relevant configuration.

`EtherCATConfig : Config : Slave : ProcessData : Sm`

- Elements
  - SyncManagerSettings : StartAddress
  - SyncManagerSettings : ControlByte
  - SyncManagerSettings : Enable
- Purpose
  Used to configure the Sync Manager registers for the process data of an EtherCAT slave.

`EtherCATConfig : Config : Slave : DC`

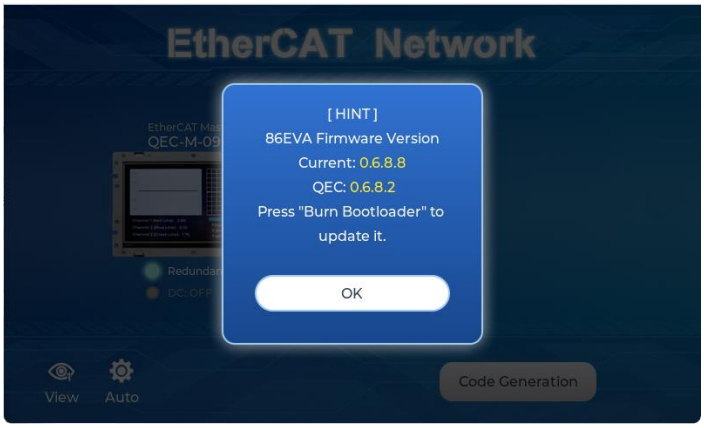
- Elements
  - CycleTime0
  - CycleTime1
  - ShiftTime
- Purpose

  Used to configure the DC parameters of an EtherCAT slave.

A2. Troubleshooting

QEC-M-01 cannot successfully upload code

When you are unable to successfully upload code, please open 86EVA to check if your QEC EtherCAT Master's environment is abnormal. As shown in the figure below, please try updating your QEC EtherCAT Master's environment, which will include the following three items: Bootloader, EtherCAT firmware, and EtherCAT tool.



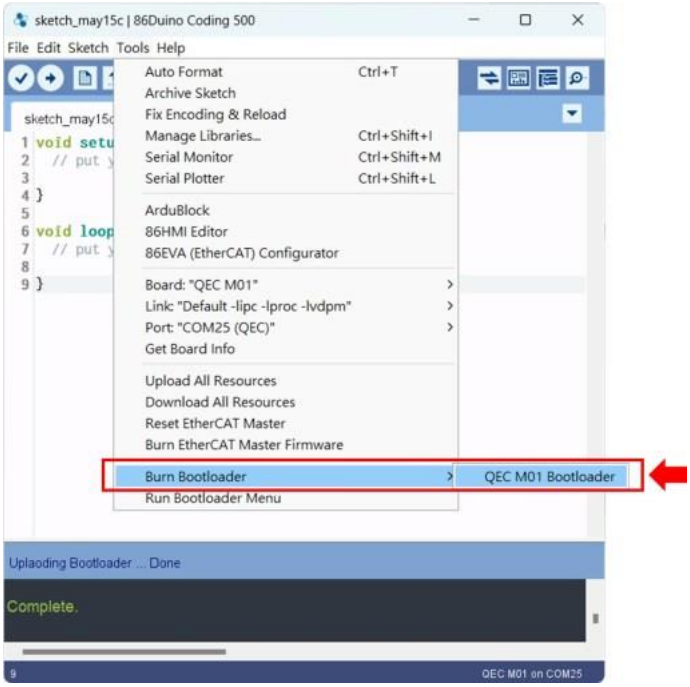
Now, we will further explain how to proceed with the update:

Step 1: Setting up QEC-M

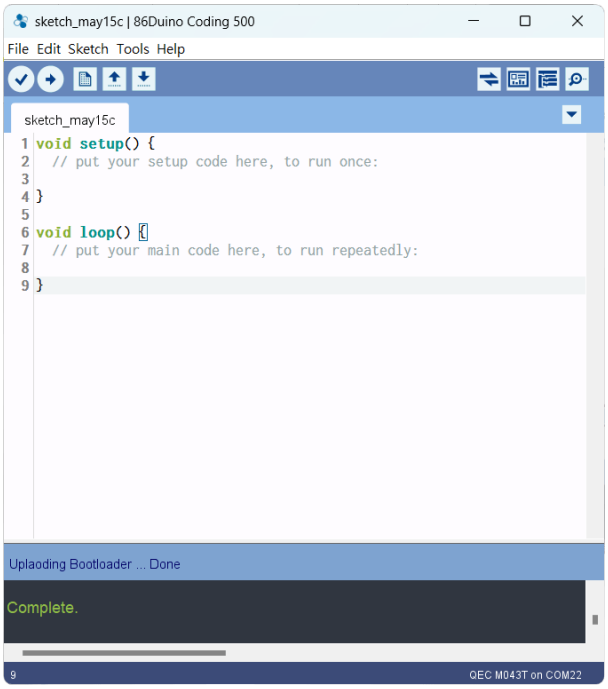
1. Download and install 86Duino IDE 500 (or a newer version): You can download it from Software.
2. Connect the QEC-M: Use a USB cable to connect the QEC-M to your computer.
3. Open 86Duino IDE: After the installation is complete, open the 86Duino IDE software.
4. Select Board: From the IDE menu, choose “Tools” > “Board” > “QEC-M-01” (or the specific model of QEC-M you are using).
5. Select Port: From the IDE menu, choose “Tools” > “Port” and select the USB port to which the QEC-M is connected.

Step 2: Click “Burn Bootloader” button

After connecting to your QEC-M product, go to “Tools”> “Burn Bootloader”. The currently selected QEC-M name will appear. Clicking on it will start the update process, which will take approximately 5-20 minutes.
QEC-M-01:



Step 3: Complete the Update



After completing the above steps, your QEC-M has been successfully updated to the latest version of the development environment.

Warranty

This product is warranted to be in good working order for a period of one year from the date of purchase. Should this product fail to be in good working order at any time during this period, we will, at our option, replace or repair it at no additional charge except as set forth in the following terms. This warranty does not apply to products damaged by misuse, modifications, accident or disaster. Vendor assumes no liability for any damages, lost profits, lost savings or any other incidental or consequential damage resulting from the use, misuse of, originality to use this product. Vendor will not be liable for any claim made by any other related party. Return authorization must be obtained from the vendor before returned merchandise will be accepted. Authorization can be obtained by calling or faxing the vendor and requesting a Return Merchandise Authorization (RMA) number. Returned goods should always be accompanied by a clear problem description.